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EXAMINER

PERKINS, PAMELA E

ART UNIT

PAPER NUMBER

2822

DATE MAILED: 02/13/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/675,627

Applicant(s)

RUMER ET AL

Examiner

Pamela E Perkins

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 26 November 2002.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-22 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-22 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☒ The proposed drawing correction filed on 26 November 2002 is: a) ☒ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

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DETAILED ACTION

This office action is in response to the filing of the amendment on 26 November 2002. Claims 1-22 are pending.

Drawings

The formal drawings were received on 26 November 2002. These drawings are approved by the examiner.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

The changes made to 35 U.S.C. 102(e) by the American Inventors Protection Act of 1999 (AIPA) do not apply to the examination of this application as the application being examined was not (1) filed on or after November 29, 2000, or (2) voluntarily published under 35 U.S.C. 122(b). Therefore, this application is examined under 35 U.S.C. 102(e) prior to the amendment by the AIPA (pre-AIPA 35 U.S.C. 102(e)).

Claim 1 is rejected under 35 U.S.C. 102(e) as being anticipated by Baum et al. (6,143,191).

Baum et al. disclose a method of forming an oriented metal layer on a substrate where a substrate is placed in a deposition chamber comprising a source of metal, depositing the metal layer onto the substrate by physical vapor deposition (PVD) in a atmosphere that comprises hydrogen (col.2, lines 21-33; col. 4, lines 40-46; col. 5, lines 26-38).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 2, 4, 9 and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Baum et al. in view of Besser et al. (5,738,917).

Baum et al. disclose a method of forming an oriented metal layer on a substrate where a substrate is placed in a deposition chamber comprising a source of metal, depositing the metal layer onto the substrate by physical vapor deposition (PVD) in a atmosphere that comprises hydrogen (col.2, lines 21-33; col. 4, lines 40-46; col. 5, lines 26-38). Baum et al. do not disclose sputter depositing the metal layer, the atmosphere further comprising argon or the metal layer as titanium.

Besser et al. disclose a method of forming an oriented titanium layer on a substrate where a titanium layer (530) is sputter deposited onto a substrate (500) in an atmosphere comprising argon, then forming an aluminum layer (540), with a <111>

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orientation, on the titanium layer (530). Besser et al. further disclose forming a titanium nitride layer (550), with a $\langle 111 \rangle$ orientation over the titanium layer (530) (col. 5, lines 15-42).

Since Baum et al. and Besser et al. are both from the same field of endeavor, a method of forming an oriented metal layer on a substrate, the purpose disclosed by Besser et al. would have been recognized in the pertinent art of Baum et al. Therefore, it would have been obvious to one ordinary skill in the art at the time the invention was made to modify Baum et al. by sputter depositing a titanium layer and the atmosphere comprising argon as taught by Besser et al. to reduce resistance (col. 2, lines 9-33).

Claims 3, 18, 20 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Baum et al. in view of Besser et al. as applied to claims 1, 2, 4, 9 and 10 above, and further in view of Yamadai (6,083,830).

Baum et al. disclose a method of forming an oriented metal layer on a substrate where a substrate is placed in a deposition chamber comprising a source of metal, depositing the metal layer onto the substrate by physical vapor deposition (PVD) in a atmosphere that comprises hydrogen (col.2, lines 21-33; col. 4, lines 40-46; col. 5, lines 26-38). Baum et al. in view of Besser et al. do not disclose the titanium layer having a $\langle 002 \rangle$ orientation.

Yamadai discloses a method of forming a layer on a substrate where a titanium layer (3), with a $\langle 002 \rangle$ orientation, is sputter deposited on a substrate (1), then a titanium nitride layer (4), with a preferred $\langle 111 \rangle$ orientation, is formed on the titanium

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layer (3) and an aluminum layer (5), with a <111> orientation, is formed on the titanium nitride layer (4) (col. 3, line 17 thru col. 5, line 41; col. 5, lines 1-33).

Since Baum et al. and Yamadai are both from the same field of endeavor, a method of forming an oriented metal layer on a substrate, the purpose disclosed by Yamadai would have been recognized in the pertinent art of Baum et al. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Baum et al. by the titanium layer having a <002> orientation, the titanium nitride layer having a <111> orientation and the aluminum layer having a <111> orientation as taught by Yamadai. A titanium layer with a <002> orientation prevents the formation of side-hole, openings in the sidewalls (col. 2, lines 21-55).

Claims 5 and 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Baum et al. in view of Besser et al. and Yamadai as applied to claims 1-4, 9, 10, 18, 20 and 21 above, and further in view of Freeman et al. (5,466,522).

Baum et al. disclose a method of forming an oriented metal layer on a substrate where a substrate is placed in a deposition chamber comprising a source of metal, depositing the metal layer onto the substrate by physical vapor deposition (PVD) in a atmosphere that comprises hydrogen (col.2, lines 21-33; col. 4, lines 40-46; col. 5, lines 26-38). Baum et al. in view of Besser et al. and Yamadai do not disclose the gas mixture during sputter deposition comprising at least 0.1 mole percent hydrogen.

Freeman et al. a method of forming a layer over a substrate where a substrate is placed in a sputter chamber containing a gas mixture of argon and hydrogen in the atmosphere and sputter depositing a layer over the substrate. Freeman et al. further

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disclose the gas mixture comprising at least 4 mole percent hydrogen (col. 4, lines 7-57).

Since Baum et al. and Freeman et al. are both from the same field of endeavor, a method of forming an oriented metal layer on a substrate, the purpose disclosed by Freeman et al. would have been recognized in the pertinent art of Baum. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Baum et al. by the gas mixture during sputter deposition comprising at least 4 mole percent hydrogen as taught by Freeman et al. The higher the concentration of hydrogen in the atmosphere during sputter deposition there is an increase in the coercivity of the film formed on the substrate, meaning the polarity of the material changes only under the influence of a relatively large magnetic field (col. 7, lines 7-57).

Claims 6 and 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Baum et al. in view of Besser et al. and Yamadai as applied to claims 1-4, 9, 10, 18, 20 and 21 above, and further in view of Kaloyeros et al. (6,139,922).

Baum et al. disclose a method of forming an oriented metal layer on a substrate where a substrate is placed in a deposition chamber comprising a source of metal, depositing the metal layer onto the substrate by physical vapor deposition (PVD) in a atmosphere that comprises hydrogen (col.2, lines 21-33; col. 4, lines 40-46; col. 5, lines 26-38). Baum et al. in view of Besser et al. and Yamadai do not disclose providing power to the target with a power density of 3 to 8 watts per square centimeter.

Kaloyeros et al. disclose a method of forming a film over a substrate by a method of sputtering. Kaloyeros et al. further disclose the power used in the sputtering method having a power density of between 0.01 W/cm^2 and 10 W/cm^2 (col. 10, lines 60-67; col. 11, lines 1-17).

Since Baum et al. and Kaloyeros et al. are both from the same field of endeavor, a method of forming an oriented metal layer on a substrate, the purpose disclosed by Kaloyeros et al. would have been recognized in the pertinent art of Baum et al. Therefore, it would have obvious to one of ordinary skill in the art at the time the invention was made to modify Baum et al. by applying powering to the target with a power density of 0.01 W/cm^2 to 10 W/cm^2 as taught by Kaloyeros et al. Under such conditions undesirable film contamination and electrical damage to the film are prevented (col. 11, lines 1-17).

Claims 11-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Baum et al. in view of Besser et al. as applied to claims 1, 2, 4, 9 and 10 above, and further in view of Miyasaka (6,124,154).

Baum et al. disclose a method of forming an oriented metal layer on a substrate where a substrate is placed in a deposition chamber comprising a source of metal, depositing the metal layer onto the substrate by physical vapor deposition (PVD) in a atmosphere that comprises hydrogen (col.2, lines 21-33; col. 4, lines 40-46; col. 5, lines 26-38). Baum et al. in view of Besser et al. do not disclose a first gas injector introducing argon and hydrogen and a second gas injector introducing an inert gas in the sputter chamber.

Referring to claims 11-14, Miyasaka discloses a method of forming a thin film over a substrate (10) in an atmosphere on hydrogen in argon with an inert gas (col. 5, lines 57-67; col. 6, lines 1-25).

Since Baum et al. and Miyasaka are both from the same field of endeavor, a method of forming an oriented metal layer on a substrate, the purpose disclosed by Miyasaka would have been recognized in the pertinent art of Baum et al. Therefore, it would have obvious to one of ordinary skill in the art at the time the invention was made to modify Baum et al. by the first gas injector introducing argon and hydrogen, the second gas injector introducing an inert gas into the atmosphere as taught by Miyasaka because under such conditions the semiconductor atoms are easily scattered to produce high purity layers (col. 6, lines 1-25).

Referring to claims 15-17, Miyasaka does not disclose at least 0.5×10^{-4} standard cubic centimeters of hydrogen per square centimeter of target surface area or a power density on the target between 0.5 and 8 watts per square centimeter of target area. It would have been obvious to one having ordinary skill in the art at the time invention was made to have at least 0.5×10^{-4} standard cubic centimeters of hydrogen per square centimeter of target surface area or a power density on the target between 0.5 and 8 watts per square centimeter of target area as disclosed in the claimed invention, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233 (CCPA 1955).

Claims 19 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Baum et al. in view of Besser et al. and Yamadai as applied to claims 1-4, 9, 10, 18, 20 and 21 above, and further in view of Hsu et al. (6,329,282).

Baum et al. disclose a method of forming an oriented metal layer on a substrate where a substrate is placed in a deposition chamber comprising a source of metal, depositing the metal layer onto the substrate by physical vapor deposition (PVD) in a atmosphere that comprises hydrogen (col.2, lines 21-33; col. 4, lines 40-46; col. 5, lines 26-38). Baum et al. in view of Besser et al. and Yamadai do not disclose the aluminum layer with a full width at half maximum (FWHM) x-ray diffraction signal of less than about 1.5 degrees.

Hsu et al. disclose a method of forming a titanium (9), titanium nitride (11), aluminum (19) interconnect. Hsu et al. further disclose the aluminum layer having a FWHM of 1.5 degrees (col. 3, lines 11-65).

Since Baum et al. and Hsu et al. are both from the same field of endeavor, a method of forming an oriented metal layer on a substrate, the purpose disclosed by Hsu et al. would have been recognized in the pertinent art of Baum et al. Therefore, it would have obvious to one of ordinary skill in the art at the time the invention was made to modify Baum et al. by the aluminum layer having a FWHM of 1.5 degrees as taught by Hsu et al. because it improve the crystallographic orientation of the aluminum layer.

Hsu et al. do not disclose the aluminum layer having a FWHM of less than 1.5 degrees. It would have been obvious to one having ordinary skill in the art at the time invention was made to have a FWHM of less than 1.5 degrees for the aluminum layer,

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since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233 (CCPA 1955).

Response to Arguments

Applicant's arguments with respect to claims 1-22 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Sullivan et al. (5,821,680) disclose using a hydrogen or nitrogen atmosphere to deposit a layer.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Pamela E Perkins whose telephone number is (703) 605-4299. The examiner can normally be reached on Monday thru Friday, 9:00am to 5:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian can be reached on (703) 308-4905. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9318 for regular communications and (703) 872-9319 for After Final communications.

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Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

pep
February 10, 2003



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